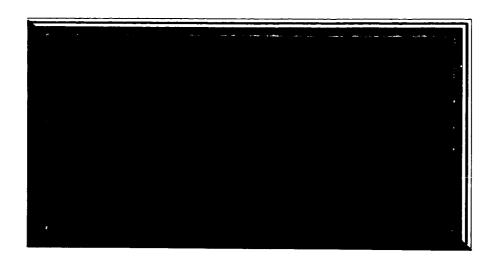
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# VOYAGER SPACECRAFT SYSTEM PRELIMINARY DESIGN

# 1969 OPERATIONAL SUPPORT EQUIPMENT DESIGN

**VOLUME E** 

PERFORMED UNDER
CONTRACT NO. 951112

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for

JET PROPULSION LABORATORY

4800 OAK GROVE DRIVE

PASADENA, CALIFORNIA



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#### INTRODUCTION

This volume contains functional descriptions of the Operational Support Equipment recommended for the 1969 Voyager Spacecraft. It is submitted as a part of the phase IA study report, in accordance with the requirements of Contract JPL (95112).

The approach taken to the design of 1969 OSE was to maximize the capabilities of (1) using the same OSE in 1971 used in 1969, and (2) converting 1969 OSE to a 1971 configuration by modification. This approach has been reflected in Volume C, which describes the 1971 OSE. This volume, accordingly, has been written on a differential basis. The functional descriptions and other documents contained herein reflect the differences between the two sets of equipment. The modification of these items would serve to convert the equipment.

Inasmuch as the study effort addressed the 1971 OSE first, the descriptions of the 1971 equipment in Volume C do not reflect any provisions that are peculiar to the 1969 usage. The corresponding functional descriptions of this volume are addressed to these 1969 features. The features would not be eliminated after the 1969 mission, but would merely not be used in 1971.

OSE recommended for 1969 only, and OSE with unique requirements for 1969, is covered by functional descriptions in this volume.

# CII - VA260

# OPERATIONAL SUPPORT EQUIPMENT

# SYSTEM TEST COMPLEX

# Index

1	Objectives and Design Criteria
2	Design Characteristics and Restraints
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#### 1.0 OBJECTIVES AND DESIGN CRITERIA

#### 1.1 SCOPE

It is the intent of this section to define those test objectives and design criteria which should be applied to the Operational Support Equipment (OSE) which forms the System Test Complex, necessary to support the Voyager 1969 test and evaluation program. The System Test Complex will be the basic test equipment used in the tests and operations at the Spacecraft Checkout Facility, Eastern Test Range, and at the Spacecraft Checkout Facility, Jet Propulsion Laboratories, for verification of the adequacy of spacecraft design, fabrication, assembly and flight readiness. The System Test Complex will also be used at the Spacecraft contractor's plant for spacecraft performance testing.

#### 1.2 APPLICABLE DOCUMENTS

 $\mathbf{G}\mathbf{E}$ 

VA211SR101 1969 Voyager Mission Objectives and Design Criteria

VA220SR101 1969 Voyager Design Characteristics

VA220SR102 1969 Voyager Design Constraints

#### 1.3 OBJECTIVES

The objectives of the 1969 Voyager STC are identical to the objectives of the 1971 Voyager STC, except that they are addressed to the earlier spacecraft. These objectives have been delineated in Volume C, VB260SR101.

#### 1.4 DESIGN CRITERIA

The 1969 STC design criteria for system testing are identical to the 1971 STC design criteria for system testing (paragraph 4.2, VB260SR101, Volume C) except that the spacecraft simulation is to be accomplished with the equipment described in VA260FD108. This reflects the design requirements of the Spacecraft Simulator which are peculiar to the 1969 Voyager Spacecraft.

The general design criteria applicable to the 1969 STC are identical to those governing the 1971 STC (paragraph 4.3, VB260SR101, Volume C). One additional criterion exists for the 1969 System Test Complex. This is that the 1969 STC design be such that analogous parts be usable to form the 1971 STC, and that all parts peculiar to the 1969 flight have the maximum practicable capability of being modified to become suitable for integration into the 1971 STC.

#### 2.0 DESIGN CHARACTERISTICS AND RESTRAINTS

This presents a general description of the System Test Complex for the 1969 Voyager Spacecraft. The design characteristics and design restraints applicable to the 1969 STC are also given. This constitutes a controlling document for the functional descriptions of 1969 STC equipment.

#### 2.1 GENERAL DESCRIPTION

#### 2.1.1 SYSTEM TEST COMPLEX

The general description of the 1971 STC, given in VB260SR102, Volume C, is applicable to the 1969 STC.

#### 2.1.2 PRE-LAUNCH FACTORY TEST PROFILE

The pre-launch factory test profile delineated in VB260SR102, Volume C, is identical to the profile applicable to the 1969 STC.

#### 2.2 BASIC DESIGN CHARACTERISTICS

The basic design characteristics of the 1971 Voyager STC, given in VB260SR101, are applicable to the 1969 Voyager STC.

## 2.3 GENERAL PURPOSE STC EQUIPMENT DESIGN CHARACTERISTICS

The design characteristics of the 1969 Voyager general purposes STC Equipment are the same characteristics stated in VB260SR101, Volume C, for the 1971 Voyager STC.

Table 2-1 is an OSE matrix which shows the degree of common utilization of equipment between the 1969 and 1971 spacecrafts. Those general purpose portions of the STC which are listed as being common, have characteristics and functional descriptions as given in Volume C. Hence, they are not covered in this volume. Those components which are either capable of conversion between 1969 - 1971 configuration, or are unique to the 1969 mission have the same design characteristics as listed in Volume C, but have functions which are described in this volume.

# 2.4 SPACECRAFT SUBSYSTEM PECULIAR STC EQUIPMENT, DESIGN CHARACTERISTICS

The design characteristics stated in VB260SR101, for the 1971 STC, are equally applicable to the analogous 1969 equipment. Functional characteristics are delineated in this volume for only those equipments which are not entirely common to both the 1969 and 1971 configurations, as shown in Table 2-1.

Table 2-1. Utilization Matrix of Equipment for the Voyager Operational Support Equipment

	Equipment Common to 1969 and 1971	Equipment Capable of Conversion 1969 to 1971	Equipment with Unique 1969 Configuration	Equipment with Unique 1971 Configuration
		Test Conductor's Console		
System Test Complex	Computer Data System Central Recorder Central Time and Synch (T.I. U.) Command Verification Equipment	Ground Power Distribution Computer Driven Printers and Displays		
Equipment	Radio Subsystem OSE Command Subsystem OSE Relay Radio Subsystem OSE Data Encoder Subsystem OSE Data Storage Subsystem OSE Controller and Sequencer SS OSE	Power Subsystem OSE Pyro Test OSE Science Package Provisions	Spacecraft Umbilical Simulator	Spacecraft Umbilical Simulator Capsule Provisions
Launch Complex Equipment Launch Area	Telecommunications S. S. OSE Controller and Sequencer OSE Guidance and Control OSE	Power Subsystem OSE Porratechnics Subsystem OSE		
Launch Area and Explosive Safe Area	Propellant and Gas Service Equipment Leak Test Equipment Pyrotechnics Installation and Test Equipment			
Assembly, Handling and Shipping Equipment	Magnetic Mapping Equipment Weight and Balance Equipment Shipping Container (Engine)	Assembly Fixtures Interface Fixtures Alignment Equipment S/C Handling Equipment	Shipping Containers (S/C and Arrays)	Shipping Containers (S/C and Arrays)
Mission Dependent Equipment	DSIF Modulators and Demodulator SFOF Demodulator	DSIF Software SFOF Software	Capsule Radio Simulator	

#### 2.5 DESIGN CONSTRAINTS

The design constraints imposed upon the 1971 STC by VB260SR101, Volume C, are equally applicable to the design of the 1969 STC.

#### 2.5.1 DIRECT-ACCESS FUNCTIONS

The direct-access functions for the 1969 S/C are identical to those which are found in Table 5-1 of VB260SR102 except for the following changes:

- A. Data Storage the following functions are added to the '69 S/C:
  - 1. Output NRZ Data
  - 2. Bit Sync
  - 3. Input NRZ science data
  - 4. Input RZ Bit sync low rate
  - 5. Input NRZ vibration data
  - 6. Input RZ bit sync high rate
- B. Data Storage the following functions are added to the '69 S/C:
  - 1. Maneuver diagnostic commutator enable.
  - 2. Engineering diagnostic commutators enable.
  - 3. Vibration data commutator enable.
- C. Science Unknown, but will assume changes.
- D. Pyro There will be fewer squib functions required.

#### 2.5.2 UMBILICAL FUNCTIONS

The umbilical functions for the 1969 S/C are identical to those which are found in Table 5-2 of VB260SR101 except for the deletion of the Capsule functions from the 1969 S/C, and the possibility of changes in the science functions.

#### 3.0 TEST CONDUCTOR'S CONSOLE

#### 3.1 SCOPE

This section is a functional description of the Test Conductor's Console in the System Test Complex, used to support the 1969 Voyager mission

#### 3.2 APPLICABLE DOCUMENTS

GE

VA260 Section 1, 1969 Voyager Spacecraft STC Test Objectives and

Objectives and Design Criteria for 1969 Flights

VA260 Section 2, 1969 Voyager Spacecraft STC Design Characteristics

and Restraints

VB260FD104 1971 Voyager Spacecraft STC Test Conductor's Console;

Functional Description

#### 3.3 FUNCTIONAL DESCRIPTION

The STC's Test Conductor's Console required to support the 1969 Voyager test program will have essentially identical functional requirements as the Test Conductor's Console required for the 1971 flights (as described in Volume C, VB260FD104). The only difference expected being in the number of lights and meters required (1971 configuration requiring more) and their markings. The additional light and meter capacity is not required for the 1969 System Test Complex.

#### 3.4 INTERFACE DEFINITION

As in VB260FD104

#### 3.5 PERFORMANCE

As in VB260FD104

#### 3.6 CHARACTERISTICS AND CONSTRAINTS

As in VB260FD104

#### 3.7 SAFETY

As in VB260FD104

#### 4.0 POWER AND DISTRIBUTION

#### 4.1 SCOPE

This section is a functional description of the facilities power and distribution required for the System Test Complex for the 1969 Voyager Spacecraft.

#### 4.2 APPLICABLE DOCUMENTS

GE

VA260 Section 1, 1969 Voyager Spacecraft, STC Objectives and

Design Criteria

VA260 Section 2, 1969 Voyager Spacecraft, STC Design Character-

istics and Restraints

VB260FD102 1971 Voyager Spacecraft, System Test Complex, Power

and Distribution, Functional Description

#### 4.3 FUNCTIONAL DESCRIPTION

The functional description of the 1971 Power and Distribution Console, defined in VB260FD102, Volume C, is applicable to the 1969 Power and Distribution Console.

#### 4.4 INTERFACE DEFINITIONS

The interfaces of the Power and Distribution Console are the same as defined in VB260FD102, except that the interface with Capsule OSE is not utilized.

#### 4.5 PERFORMANCE PARAMETERS

The performance parameters defined in VB260FD102, Volume C, are applicable.

#### 4.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

The Physical characteristics defined in VB260FD102, Volume C, are applicable.

#### 4.7 SAFETY

The Safety provisions defined in VB260FD102, Volume C, are applicable.

#### 5.0 PRINTERS AND DISPLAYS

#### 5.1 SCOPE

This section is a functional description of the printers and displays used by the Computer Data System, in the 1969 System Test Complex, to display system and subsystem test data.

#### 5.2 APPLICABLE DOCUMENTATION

 $\mathbf{G}\mathbf{E}$ 

VB260FD105 1971 Voyager Spacecraft STC, Printers and Displays,

Functional Description

VB260FD103 1971 Voyager Spacecraft STC, Computer Data System,

Functional Description

VA260 Section 1, 1969 Voyager Spacecraft STC Objectives and

Design Criteria

VA260 Section 2, 1969 Voyager Spacecraft, System Test Complex,

Design Characteristics and Restraints

#### 5.3 DESCRIPTION

The Printers and Displays in the 1969 System Test Complex will be functionally identical to those used in the 1971 System Test Complex, described in VB260FD105, Volume C. Their numbers, software and physical allocation will, however, reflect the requirements of the 1969 mission. Typical of this is the Science display and the absence of any Capsule displays.

#### 5.4 INTERFACE DEFINITION

Same as described in VB260FD105

#### 5.5 PERFORMANCE PARAMETERS

Same as described in VB260FD105

#### 5.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

Same as described in VB260FD105

#### 5.7 SAFETY PROVISIONS

Same as described in VB260FD105

#### 6.0 POWER SUBSYSTEM OSE

#### 6.1 SCOPE

This section is a functional description of the Power Subsystem OSE in the System Test Complex which supports the 1969 Voyager Spacecraft.

#### 6.2 APPLICABLE DOCUMENTS

GE

VB266FD101 1971 Voyager Spacecraft System Test Complex, Power Sub-

system OSE, Functional Description

VA260 Section 1, 1969 Voyager Spacecraft STC Objectives and

Design Criteria

VA260 Section 2, 1969 Voyager Spacecraft STC Design Character-

istics and Restraints

VA236FD101 1969 Voyager Spacecraft Power Subsystem, Functional

Description

#### 6.3 FUNCTIONAL DESCRIPTION

The functional description of the Power Subsystem OSE for the STC is equally valid for Voyager 1969. Refer to Volume C, VB266FD101.

Vehicle differences consist primarily of the 1969 Spacecraft having one less battery than the 1971 Spacecraft. The power subsystem is still functionally the same. The reduced number of batteries will result in a reduced number of umbilical and direct-access test points. Therefore, the Power OSE in 1969 will have fewer monitor points than in 1971, but the 1971 OSE is to be used for 1969.

#### 6.4 INTERFACE

Same as 1971 Voyager; refer to Volume C, VB266FD101, Section 4.0. The actual number of umbilical and direct-access points will be reduced by a few wires, but the interfaces are functionally identical.

#### 6.5 PERFORMANCE PARAMETERS

Same as 1971 Voyager; refer to Volume C, VB266FD101, Section 5.0.

#### 6.6 PHYSICAL CHARACTERISTICS

Same as 1971 Voyager; refer to Volume C, VB266FD101, Section 6.0.

#### 6.7 SAFETY CONSIDERATIONS

Same as 1971 Voyager; refer to Volume C, VB266FD101, Section 7.0.

#### 7.0 PYROTECHNIC SUBSYSTEM OSE

#### 7.1 SCOPE

This section is a functional description of the Pyrotechnic Subsystem OSE for the System Test Complex for the 1969 Voyager Spacecraft. It supports system and subsystem tests of the Pyrotechnic Subsystem.

#### 7.2 APPLICABLE DOCUMENTS

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U	Ŀ

VA260	Section 1, 1969 Voyager Spacecraft, Test Objectives and Design Criteria
VA260	Section 2, 1969 Voyager Spacecraft, Design Characteristics and Restraints
VA235FD104	1969 Voyager Spacecraft, Pyrotechnic Subsystem, Functional Description
VB265FD101	1971 Voyager Spacecraft, Pyrotechnic Subsystem OSE, Functional Description

#### 7.3 FUNCTIONAL DESCRIPTION

The functional description of the Pyrotechnic Subsystem OSE for the 1971 Voyager Spacecraft System Test Complex is valid for the 1969 Voyager Spacecraft System Test Complex. Refer to Volume C, VB265FD101, Pyrotechnic OSE, Section 3.0.

The Pyrotechnic Subsystem in the 1969 Voyager Spacecraft will function the same as the 1971 Spacecraft. There will be fewer Pyrotechnic devices used in the 1969 Spacecraft; hence, there will be monitoring and test capability in the Pyrotechnics OSE which are not required except to support the 1971 mission. There will be some differences made necessary by wiring variations in the two vehicles. These conditions can be handled by use of a junction box.

#### 7.4 INTERFACE

Refer to Volume C, VB265FD101, Section 4.0. There will be a reduction in the number of direct access points needed in the 1969 OSE because there are fewer Pyrotechnics. There are no other interface differences.

#### 7.5 PERFORMANCE CHARACTERISTICS

Same as 1971 Voyager Spacecraft, refer to Volume C, VB265FD101, Section 5.0.

#### 7.6 PHYSICAL CHARACTERISTICS AND RESTRAINTS

Same as 1971 Voyager Spacecraft, refer to Volume C, VB265FD101, Section 6.0.

#### 7.7 SAFETY CONSIDERATIONS

Same as 1971 Voyager Spacecraft, refer to Volume C, VB265FD101, Section 6.0.

#### 8.0 SCIENCE PROVISIONS

#### 8.1 SCOPE

This section is a functional description of the provisions of the 1969 System Test Complex to accommodate OSE for the 1969 Science Package.

#### 8.2 DOCUMENTATION

GE

VB262FD101/VB267FD101 1971 Voyager Spacecraft, System Test Complex,

Provision for Science and Capsule OSE;

Functional Description

VA260 Section 1, 1969 Voyager Spacecraft STC

Objectives and Design Criteria

VA260 Section 2, 1969 Voyager Spacecraft, System Test

Complex, Design Characteristics and Restraints

#### 8.3 DESCRIPTION

The 1969 mission does not include a capsule and will have different Science than the 1971 Mission. The STC provisions to accommodate this Science OSE are as defined in document VB262FD101/VB267FD101. It is probable that these provisions would be allocated and utilized differently in the two missions.

#### 8.4 INTERFACES DEFINITION

As defined by VB262FD101/VB267FD101.

#### 8.5 PERFORMANCE PARAMETER

As defined by VB262FD101/VB267FD101.

#### 8.6 PHYSICAL CHARACTERISTICS AND CONSTRAINT

As defined by VB262FD101/VB267FD101.

#### 8.7 SAFETY PROVISION

As defined by VB262FD101/VB267FD101.

#### 9.0 DATA ENCODER OSE

#### 9.1 SCOPE

This section describes the Data Encoder Operational Support Equipment necessary for the System Test Complex to checkout, test and demonstrate the S/C DE operation during systems test for the 1969 Voyager mission. This functional description includes that equipment necessary to test and calibrate the Data Encoder as an electrically isolated subsystem during subsystem tests, while installed in the spacecraft. This functional description delineates the additional capability required to accommodate the 1969 mission.

#### 9.2 APPLICABLE DOCUMENTS

GE

VA260 Section 1, 1969 Voyager Spacecraft STC Test Objectives

and Design Criteria

VA260 Section 2, 1969 Voyager Spacecraft STC Design Character-

istics and Restraints

VB263FD106 1971 Voyager Spacecraft Data Encoder OSE, Functional

Description

#### 9.3 FUNCTIONAL DESCRIPTION

The DE OSE required for the 1969 mission is basically the same as that required for the 1971 mission described in Volume C, functional description VB263FD106. The 1969 OSE, which is identical to the 1971 OSE configuration, utilizes capability not otherwise required by the 1971 mission. The following 1971 DE OSE functional units are required to provide the capability imposed by the increased complexity of the spacecraft DE:

Stimulator/Calibrator

Monitor and Displays

Command and Control

Decommutator

S/C Power Supply Simulator

The stimulator/calibrator is capable of providing the required stimulus, however, additional programming or controls are required.

The increased complexity of the S/C DE increases the number of controls and stimulation requirements. The number of selectable displays will remain at five.

The decommutator requires no additional hardware. However, a new program is required. The new program will be basically that of the 1971 mission described in Volume C functional description VB263FD106. The program will be expanded to accommodate the additional submultiplexing as shown in Table 9-1 and the program data types shown in Table 9-2. The S/C power simulator is required to be capable of supplying additional power as required by the DE for the 1969 mission.

In the areas of self, subsystem and system testing the test procedures require modification to accommodate the 1969 mission. The 1971 tests will apply, but require additional test for the additional commutators not included in the 1971 S/C DE.

#### 9.4 INTERFACE DEFINITION

The umbilical connections for the 1969 OSE are unchanged from those for 1971. The direct access test points for 1969 are the same as for 1971 with the following additions:

- 20-v monitor
- + 3.5-v monitor

Fable 9-1. Data Mode Commutation Formats

- 0	Engineering Approach Diagnostic Guidance Data Data									
			ı	ı	1			1 1	ı	38
			ı	25	30 x 3	Length		1 1	30 x 3	25
	Diagnostic tta	Medium Deck Channels	l	09	1			09	l	09
	Maneuver Diagnostic Data	High Deck Channels	1	10	1	o channel Ma		10	1	14
	Engineering Data	Low Deck Channels	I	110	100	  10 <sup>6</sup>		1 1	100	100
		Medium Deck Channels	70	110	110	1 × 1		70	110	110
		High Deck Channels	46	02	06			46	06	0.2
	Mode		Maneuver (I)	Cruise (II)	Normal Orbit (III) (a) Buffered Data	(b) MTR High Speed Vibration Data	MCM Dump (IV)	(a) 1. Engineering 2. Maneuver Diagnostic	(b) Non Scan Orbital (V)	Approach Guidance (VI)

Table 9-2. Program Data Types

Description	Engineering Data	<ol> <li>Engineering Data</li> <li>Maneuver Diagnostic Data</li> <li>Engineering Diagnostic Data</li> </ol>	<ol> <li>Engineering Data</li> <li>Maneuver Diagnostic Data</li> <li>Engineering Diagnostic Data</li> </ol>	<ol> <li>Engineering Data</li> <li>Interplanetary Science</li> <li>Engineering Diagnostic Data</li> </ol>	Planet Scan Data	<ol> <li>Engineering Data</li> <li>Engineering Diagnostic Data</li> </ol>	Blocks of Mode I Engineering Data	Blocks of Engineering Data and Engineering Diagnostic Data	Blocks of Maneuver Diagnostic Data	<ol> <li>Engineering Data</li> <li>Engineering Diagnostic Data</li> </ol>	<ol> <li>Engineering</li> <li>Maneuver Diagnostic Data</li> <li>Engineering Diagnostic Data</li> <li>Approach Guidance Data</li> </ol>
Data Type	A	Д	$\mathbf{B_1}$	${\tt B}_2$	C	D	A	Q	田	D	ŭ
Data Rate BPS	3 1/3	106 2/3	106 2/3	106 2/3	8533 1/3		2133 1/3			8533 1/3	106 2/3
Data Mode	Н	Ħ			Ш		IV			Λ	VI
Transmission Mode	Maneuver Mode	Cruise Mode			Orbit Mode		Memory Dump	Mode		Non-Scan Orbital Mode	Approach Guidance Mode

#### 9.5 PERFORMANCE PARAMETERS

Same as the 1971 mission as shown in Volume C functional description VB263FD106.

#### 9.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

Same as the 1971 mission as shown in Volume C functional description VB263FD106.

#### 9.7 SAFETY CONSIDERATIONS

Same as the 1971 mission as shown in Volume C functional description VB263FD106.

#### 10.0 DATA STORAGE OSE

#### 10.1 SCOPE

This document describes the Data Storage Operational Support Equipment necessary to support system and subsystem testing of the 1969 Voyager Spacecraft Data Storage Subsystem.

#### 10.2 APPLICABLE DOCUMENTS

 $\mathbf{GE}$ 

VA260 Section 1, 1969 Voyager Spacecraft, STC Objectives and

Design Criteria

VA260 Section 2, 1969 Voyager Spacecraft, STC Design Character-

istics and Restraints

VB263FD105 1971 Voyager Spacecraft, Data Storage OSE, Functional

Description

#### 10.3 FUNCTIONAL DESCRIPTION

The DS OSE required for the 1969 mission is basically the same as the 1971 DS OSE described in VB263FD105. The 1969 DS OSE has additional controls and monitors, and an additional spacecraft power supply simulator to support testing of the additional 1969 spacecraft components.

#### 10.4 INTERFACE DEFINITION

The 1969 DS OSE umbilical interface is unchanged from that of 1971 DS OSE.

#### **CII - VA260**

The direct access test points for 1969 are the same as for 1971 with the following additions:

- +3.5-v monitor
- -3.0-v monitor
- +28-v monitor

NRZ data and bit sync from 1969 MTR Selector

#### 10.5 PERFORMANCE PARAMETERS

Performance Parameters are the same as those of the 1971 mission Data Storage OSE, VB263FD105.

#### 10.6 PHYSICAL CHARACTERISTICS AND RESTRAINTS

Physical Characteristics and Restraints are the same as those of the 1971 mission Data Storage OSE, VB263FD105.

#### 10.7 SAFETY CONSIDERATIONS

Safety Considerations are the same as those of the 1971 mission Data Storage OSE, VB263FD105.

#### 11.0 STC AND LCE UMBILICAL SIMULATOR

#### 11.1 SCOPE

This document is a functional description of the Umbilical Simulator utilized in conjunction with the System Test Complex, or the Launch Complex Equipment to determine readiness to connect OSE to the 1969 Voyager Spacecraft umbilical.

#### 11.2 APPLICABLE DOCUMENTS

GE	
VA260	Section 1, 1969 Voyager Spacecraft STC Test Objectives and Design Criteria
VA260	Section 2, 1969 Voyager Spacecraft STC Design Characteristics and Restraints
VA280	Section 1, 1969 Voyager Spacecraft LCE Test Objectives and Design Criteria

VA280

Section 2, 1969 Voyager Spacecraft LCE Design Character-

istics and Restraints

VB260FD108

1971 Voyager Spacecraft, System Test Complex, Umbilical

Simulator, Functional Description

#### 11.3 FUNCTIONAL DESCRIPTION

The umbilical simulator will perform the same function, as the simulator for the 1971 spacecraft, defined in Volume C, VB260FD108, which is to validate the cabling and the OSE consoles; however, several umbilical functions are different. This requires a different arrangement of the monitoring and stimulating circuits to be compatible with the 1969 STC and LCE. The following are umbilical function differences which necessitate specific circuit arrangements in the umbilical simulator.

- a. Capsule wires are spares
- b. Science wires allocated differently
- c. Pyro wires allocated differently
- d. Some power wires become spares

#### 11.4 INTERFACE DEFINITION

Same as in VB260FD108, Volume C, except for the umbilical functions noted above.

#### 11.5 PERFORMANCE PARAMETERS

Same as in VB260FD108 Volume C.

#### 11.6 PHYSICAL CHARACTERISTICS

Same as in VB260FD108 Volume C.

#### 11.7 SAFETY CONSIDERATION

Same as in VB260FD108 Volume C.

# CII - VA280

# LAUNCH COMPLEX EQUIPMENT

# Index

1	Test Objectives and Design Criteria
2	Design Characteristics and Restraints
3	Power System OSE
4	Pyrotechnic Subsystem OSE
5	Pyrotechnic Test Kit

#### 1.0 TEST OBJECTIVES AND DESIGN CRITERIA

#### 1.1 SCOPE

This section defines the test objectives and design criteria applicable to the Launch Complex Equipment which supports the 1969 Voyager Spacecraft. This support is for confidence testing at both the Explosive Safe Area and Launch Area, pre-launch and countdown at the Launch Area, and the propellent, gases and pyrotechnics loading and testing at the Explosive Safe Area.

#### 1.2 APPLICABLE DOCUMENTS

GE

VA211SR101

1969 Voyager Spacecraft Mission Objectives and Design

Criteria

VB280SR101

1971 Voyager Spacecraft, Launch Complex Equipment,

Test Objectives and Design Criteria

#### 1.3 TEST OBJECTIVES

The test objectives of the 1969 LCE are identical to the test objectives states in VB280SR101, the Test Objectives and Design Criteria for the 1971 Voyager LCE.

#### 1.4 DESIGN CRITERIA

The design criteria for the 1969 LCE include the design criteria for the 1971 LCE, contained in document VB280SR101, except that support of the 1969 Spacecraft and its mission are the objectives of the 1969 LCE. In addition, there are two further criteria applicable to the 1969 LCE:

- a. The equipments which form the 1969 LCE should have characteristics that will provide maximum practicable utility for use in the 1971 LCE.
- b. That the 1969 LCE be compatible with the launch complex and booster assigned to the 1969 mission.

#### 2.0 DESIGN CHARACTERISTICS AND RESTRAINTS

#### 2.1 SCOPE

It is the intent of this section to define the design characteristics and design restraints to be applied to the 1969 Voyager Spacecraft Launch Complex Equipment. These characteristics and restraints apply to the design of the LCE to be used both at the Launch Area and at the Explosive Safe Area.

#### 2.2 APPLICABLE DOCUMENTS

GE

VA280 Section 1, 1969 Voyager Spacecraft Launch Complex Equip-

ment Test Objectives and Design Criteria

VA220SR101 1969 Voyager Spacecraft Design Characterists

VA220SR102 1969 Voyager Spacecraft Design Restraints

VB280SR102 1971 Voyager Spacecraft Design Restraints

#### 2.3 DESIGN CHARACTERISTICS

The design characteristics of the LCE for the 1969 Voyager are the same as the design characteristics of the 1971 Voyager, listed in document VB280SR102. The launch complex to be used for the 1969 launch will impose equal or lesser requirements on the LCE for design characteristics such as cable lengths. The 1969 LCE design characteristics should equal 1971 LCE, notwithstanding the fact that these characteristics may not be used until 1971.

The design characteristics of the 1969 LCE should include those features of modularity and function which will enable it to be converted to 1971 use. This includes redesigned module compatibility, which would be required in the case of differences between a 1969 and a 1971 version of spacecraft subsystem, and the compatibility with the 1971 launch complex as well as the 1969 launch complex.

The design characteristics of the LCE should reflect the specific interfaces of the 1969 spacecraft, insofar as umbilical access and RF access are concerned. The umbilical list, given in document, VB280SR102 for the 1971 SCE, pertains to the 1969 LCE except that capsule and science provisions will be different. Certain umbilical wires are considered to be spares in the 1969 list. These become battery monitoring and charging wires in the 1971 list.

The following equipment, part of the 1969 LCE, have either functional or physical differences from the 1971 LCE:

Data Encoder OSE

Data Storage OSE

Pyrotechnics OSE

Power Subsystem OSE

#### 2.4 DESIGN RESTRAINTS

The design restraints on the 1971 Launch Complex Equipment, stated in document VB280SR102, apply.

#### 2.5 LAUNCH COMPLEX REQUIREMENTS

The launch complex requirements stated in VB280SR102 pertain to the 1969 LCE, except that the physical characteristics of the complex used for the 1969 opportunity are determining.

#### 3.0 POWER SUBSYSTEM OSE

#### 3.1 SCOPE

This section is a functional description of the Power Subsystem OSE in the Launch Complex Equipment, required for confidence testing and pre-launch control of the Power Subsystem of the 1969 Voyager Spacecraft.

#### 3.2 APPLICABLE DOCUMENTS

GE

VA280	Section 1, 1969 Voyager Spacecraft, LCE Test Objectives and Design Criteria
VA280	Section 2, 1969 Voyager Spacecraft, LCE Design Characteristics and Restraints
VA266FD101	1969 Voyager Spacecraft, Power Subsystem; Functional Description
VB280FD103	1971 Voyager Spacecraft, LCE Power Subsystem OSE; Functional Description

#### 3.3 FUNCTIONAL DESCRIPTION

The functional description of the Power Subsystem OSE for the LCE for the 1971 Voyager Spacecraft contained in Volume C, VB280FD103, is valid for the 1969 Voyager Spacecraft Launch Complex Equipment.

The lesser number of components in the 1969 Voyager Power Subsystem will reduce the monitor and control wires required at the 1969 umbilical. The 1971 Power Subsystem LCE will be able to support the 1969 Spacecraft, with additional monitoring and battery charging capacity not required until needed for the 1971 Spacecraft.

## 3.4 PERFORMANCE PARAMETERS

Same as 1971 Voyager Spacecraft, refer to Volume C, VB280FD103, Section 5.0.

#### 3.5 PHYSICAL CHARACTERISTICS

Same as 1971 Voyager Spacecraft, refer to Volume C, VB280FD103, Section 6.0

#### 3.6 SAFETY CONSIDERATIONS

Same as 1971 Voyager Spacecraft, refer to Volume C, VB280FD103, Section 7.0.

#### 4.0 PYROTECHNIC SUBSYSTEM OSE

#### 4.1 SCOPE

This section is a functional description of the Pyrotechnic Subsystem OSE for the 1969 Voyager Spacecraft Launch Complex Equipment, required to support confidence testing and pre-launch operations involving the Pyrotechnic Subsystem.

#### 4.2 APPLICABLE DOCUMENTS

GE

VA280	Section 1, 1969 Voyager Spacecraft, LCE Test Objectives and Design Criteria
VA280	Section 2, 1969 Voyager Spacecraft, LCE Design Characteristics and Restraints
VA235FD104	1969 Voyager Spacecraft, Phrotechnic Subsystem; Functional Description
VB280FD106	1971 Voyager Spacecraft, LCE Pyrotechnic Subsystem OSE; Functional Description

#### 4.3 FUNCTIONAL DESCRIPTION

The functional description of the Pyrotechnic LCE for the 1971 Voyager Spacecraft is equally valid for the 1969 Voyager Spacecraft; refer to Volume C, VB280FD106, Section 3.0.

#### 4.4 INTERFACE

Same as in the 1971 Voyager Spacecraft; refer to Volume C, VB280FD106, Section 4.0.

#### 4.5 PERFORMANCE PARAMETERS

Same as for the 1971 Voyager Spacecraft; refer to Volume C, VB280FD106, Section 5.0.

#### 4.6 PHYSICAL CHARACTERISTICS

Same as 1971 Voyager Spacecraft; refer to Volume C, VB280FD106, Section 6.0.

The difference in quantity of Pyrotechnics used in the two spacecraft, and their identification of function, will require changing display identification. The excess capacity of the 1969 OSE is required to support the 1971 Spacecraft.

#### 4.7 SAFETY CONSIDERATIONS

Same as for the 1971 Voyager Spacecraft: refer to Volume C, VB280FD106, Section 7.0.

#### 5.0 PYROTECHNIC TEST KIT

#### 5.1 SCOPE

This section is a functional description of the portable Pyrotechnic Test Kit required to support the installation of Pyrotechnic devices in the 1969 Voyager Spacecraft at the Explosives Safe Area. It is part of the 1969 Voyager Spacecraft Launch Complex Equipment.

#### 5.2 APPLICABLE DOCUMENTS

GE

VA280	Section 1, 1969 Voyager Spacecraft, LCE Test Objectives and Design Criteria
VA280	Section 2, 1969 Voyager Spacecraft, LCE Design Characteristics and Restraints
VA235FD104	1969 Voyager Spacecraft, Pyrotechnic Subsystem; Functional Description
VA280FD111	1971 Voyager Spacecraft, Launch Complex Equipment, Pyrotechnic Test Kit: Functional Description

#### 5.3 FUNCTIONAL DESCRIPTION

The functional description for the Pyrotechnic OSE for the Explosives Safe Area for the 1971 Voyager Spacecraft is equally valid for the 1969 Voyager Spacecraft; refer to Volume C, VB280FD111.

#### CII - VA280

Modification to the spacecraft Pyrotechnic Subsystem design for 1969 consists of a reduced number of Pyrotechnics. The Portable Pyro Test Unit described for the 1971 Spacecraft can be used for the 1969 Spacecraft with different external cables and harness to accommodate the different vehicle electrical harness.

#### 5.4 INTERFACE

Same as the 1971 Voyager Spacecraft; refer to Volume C, VB280FD111, Section 4.0.

#### 5.5 PERFORMANCE PARAMETERS

Same as the 1971 Voyager Spacecraft; refer to Volume C, VB280FD111, Section 5.0.

#### 5.6 PHYSICAL CHARACTERISTICS

Same as the 1971 Voyager Spacecraft; except for a different harness and cable. Refer to Volume C, VB280FD111, Section 6.0

#### 5.7 SAFETY CONSIDERATIONS

Same as the 1971 Voyager Spacecraft; refer to Volume C, VB280FD111, Section 7.0.

# CII - VA285

# MISSION DEPENDENT EQUIPMENT

# Index

1	Objectives and Design Criteria
2	Design Characteristics and Restraints
3	DSIF Software
4	SFOF Software
5	Capsule Radio Simulator

#### 1.0 OBJECTIVES AND DESIGN CRITERIA

#### 1.1 SCOPE

It is the intent of this section to define the objectives and design criteria which should be applied to Mission Dependent hardware and software required by the Deep Space Network to implement the 1969 Voyager mission.

#### 1.2 APPLICABLE DOCUMENTATION

GE

VA211SR101

1969 Voyager Mission Objective and Design Criteria

VB280SR103

1971 Voyager MDE Objective and Design Criteria

#### 1.3 OBJECTIVES

The objectives of the 1969 MDE are exactly analogous to the 1971 MDE objectives, defined in VB280SR103, Volume C, except for being addressed to the 1969 mission.

#### 1.4 DESIGN CRITERIA

The design criteria governing the 1969 MDE are exactly analogous to those governing the 1971 MDE, defined in VB280SR103, Volume C, except for being addressed to the 1969 Mission.

#### 2.0 DESIGN CHARACTERISTICS AND RESTRAINTS

#### 2.1 SCOPE

It is the intent of this section to define the design characteristics and restraints to be applied to the design of Mission Dependent Hardware and Software required in the Deep Space Network, to implement the 1969 Voyager mission.

#### 2.2 APPLICABLE DOCUMENTS

 $\mathbf{G}\mathbf{E}$ 

VA211SR101

1969 Voyager Mission Objectives and Design Criteria

VB280SR104

1971 Voyager Mission Dependent Equipment Design Char-

acteristics and Restraints

#### 2.3 DESIGN CHARACTERISTICS AND RESTRAINTS

The design characteristics and restraints for the 1969 MDE are exactly analogous to the design characteristics and restraints governing the 1971 Voyager mission, as defined in document VB280SR104, except that they are addressed to the 1969 mission.

#### 3.0 DSIF SOFTWARE

#### 3.1 SCOPE

This section is a functional description of the software required by the Telemetry Command and Data Handling Subsystem at DSIF for processing 1969 Voyager telemetry data.

#### 3.2 APPLICABLE DOCUMENTS

GE

VA285 Section 1, 1969 Voyager Spacecraft MDE Objectives and Design Criteria

VA285 Section 2, 1969 Voyager Spacecraft MDE Characteristics and Restraints

and reput and

VB263FD106 1971 Voyager Spacecraft Functional Description, System

Test Complex Data Encoder OSE

VB280FD118 Functional Description, DSIF MDE Software 1971 Voyager

Spacecraft

#### 3.3 FUNCTION DESCRIPTION

The 1969 Voyager mission requires a program identical to the program for the 1971 mission, that will in addition, accommodate the additional S/C DE requirements as shown in Tables 3-1 and 3-2. The 1969 program is an extention to the 1971 program described in Volume C, document VB263FD106.

#### 3.4 INTERFACE DEFINITION

Same as the 1971 mission as shown in Volume C functional description VB280FD118.

#### 3.5 PERFORMANCE PARAMETERS

Same as the 1971 mission as shown in Volume C functional description VB280FD118.

Table 3-1. Data Mode Commutation Formats

	Eng	Engineering Data	ata	Maneuver Diagnostic Data	Diagnostic ta	Engineering	
Mode	High Deck Channels	Medium Deck Channels	Low Deck Chamels	High Deck Channels	Medium Deck Channels	Diagnostic Data	Guidance Data
Maneuver (I)	46	0.2	-	ı	ı	1	ı
Crusie (II)	02	110	110	10	09	25	ı
Normal Orbit (III)				,			
(a) Buffered Data	06	110	100	ı	ı	30 x 3	ı
(b) MTR High Speed Vibration Data MCM Dump (IV)		$1 \times 10^6$	bits of 20	1 x 10 <sup>6</sup> bits of 20 channel Major Frame Length	or Frame ]	Length	
(a) 1. Engineering	46	20	ı	ı	ı	I	ı
2. Maneuver Diagnostic	ı	ı	I	10	09	ı	ı
(b) Non Scan Orbital (V)	06	110	100	ì	1	30 x 3	ł
Approach Guidance (VI)	02	110	100	14	09	25	38

Table 3-2. Program Data Types

Transmission Mode	Data Mode	Data Rate BPS	Data Type	Description
Maneuver Mode	1	3 1/3	A	Engineering Data
Cruise Mode	Ħ	106 2/3	В	<ol> <li>Engineering Data</li> <li>Maneuver Diagnostic Data</li> <li>Engineering Diagnostic Data</li> </ol>
		106 2/3	$_{ m B_1}$	<ol> <li>Engineering Data</li> <li>Maneuver Diagnostic Data</li> <li>Engineering Diagnostic Data</li> </ol>
		106 2/3	B <sub>2</sub>	<ol> <li>Engineering Data</li> <li>Interplanetary Science</li> <li>Engineering Diagnostic Data</li> </ol>
Orbit Mode	Ш	8533 1/3	۵	Planet Scan Data
			D	<ol> <li>Engineering Data</li> <li>Engineering Diagnostic Data</li> </ol>
Memory Dump Mode	IV	2133 1/3	A	Blocks of Mode I Engineering Data
			Q	Blocks of Engineering Data and Engineering Diagnostic Data
			<b>Ξ</b>	Blocks of Maneuver Diagnostic Data
Non-Scan Orbital Mode	Λ	8533 1/3	D	<ol> <li>Engineering Data</li> <li>Engineering Diagnostic Data</li> </ol>
Approach Guidance Mode	VI	106 2/3	უ	<ol> <li>Engineering</li> <li>Maneuver Diagnostic Data</li> <li>Engineering Diagnostic Data</li> <li>Approach Guidance Data</li> </ol>

#### 3.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

Same as the 1971 mission as shown in Volume C functional description VB280FD118.

#### 3.7 SAFETY CONSIDERATIONS

Same as the 1971 mission as shown in Volume C functional description VB280FD118.

#### 4.0 SFOF SOFTWARE

#### 4.1 SCOPE

This section is a functional description of the mission dependent software required by the SFOF to support the 1969 mission.

#### 4.2 APPLICABLE DOCUMENTATION

GE

VB280FD120 1971 Voyager Spacecraft MDE, SFOF Software; Functional

Description

VA285 Section 1, 1969 Voyager Spacecraft; MDE Objectives and

Design Criteria

VA285 Section 2, 1969 Voyager Spacecraft MDE; Design Charac-

teristics and Restraints

VA211SR101 1969 Voyager Mission Objectives and Design Criteria

#### 4.3 DESCRIPTION

The SFOF software required for the 1969 Mission is identical to the software required for the 1971 Mission, described in document VB280FD120, Volume C, except that mission dependent programs involving Mars orbit commands are not applicable.

#### 4.4 INTERFACES

As defined in VB280FD120.

#### 4.5 PERFORMANCE PARAMETERS

As defined in VB280FD120.

## 4.6 PHYSICAL CHARACTERISTICS AND CONTRAINTS

As defined in VB280FD120.

#### 4.7 SAFETY PROVISION

As defined in VB280FD120.

#### 5.0 CAPSULE RADIO SIMULATOR

#### 5.1 SCOPE

This section describes the functional characteristics of the Capsule Radio Simulator (CRS) required to support the test program for the Relay Radio subsystem during the 1969 test mission.

#### 5.2 APPLICABLE DOCUMENTS

Reference to the following documents is required for completeness in this description:

JPL

Design Specification; Voyager Capsule Radio Subsystem

8907A - DSIF General Specification for Electronic Equipment

GE

VA285 Section 1, 19

Section 1, 1969 Voyager Spacecraft, MDE Objectives and

Design Criteria

VA285

Section 2, 1969 Voyager Spacecraft, MDE Characteristics

and Restraints

VB263FD104

1971 Voyager Spacecraft, Relay Radio Subsystem;

Functional Description

VB263FD104

1971 Voyager Spacecraft, Relay Radio Subsystem OSE;

Functional Description

#### 5.3 FUNCTIONAL DESCRIPTION

#### 5.3.1 GENERAL

The Voyager Capsule Radio Simulator is used to facilitate the 1969 flight test of the Relay Radio Subsystem by providing simulated Voyager Capsule Radio subsystem outputs.

### 5.3.2 BLOCK DIAGRAM

A functional Block diagram of the Capsule Radio Simulator is shown in Figure 5-1.

## 5.3.3 REQUIRED FUNCTIONS

The Capsule Radio Simulator is capable of performing the following functions:

- a. Provide a stable transmitted signal to the spacecraft in flight.
- b. Provide for modulation of the transmitted signal by locally generated or taped data which may be correlated with the relayed signal.
- c. Provide simulated Capsule dynamics by the use of dynamic frequency control, power control, and antenna drive control.
- d. Provide for monitoring and recording the parameters of Item c.

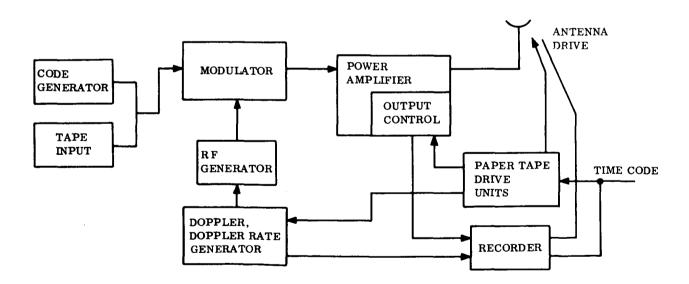


Figure 5-1. Capsule Radio Simulator

#### 5.3.4 GENERAL DESCRIPTION

The following paragraphs describe the equipment required to implement the Capsule Radio Simulator functions.

#### 5.3.4.1 CODE GENERATOR

A Pseudo Noise (PN) code generator is used to generate easily-recognized symbol sequences at the nominal bit rate (10 bits per second) for transmission to and be relayed by the spacecraft. These squences are used to determine the bit error characteristics of the complete relay link.

#### 5.3.4.2 TAPE INPUT UNIT

To assure flexibility in the test programs, a tape reader is an alternate input to the modulator. Pre-recorded tapes with simulated sensor output data or other significant code patterns can be used to test link performance.

#### 5.3.4.3 MODULATOR AND RF GENERATOR

These units are electrically identical to those specified for the Voyager Capsule, with the exception that the frequency of the RF Generator can be varied to simulate Doppler and Doppler rate.

### 5.3.4.4 POWER AMPLIFIER

The power amplifier incorporates suitable scaling flexibility (gain and attenuation) to compensate for orbital and atmospheric differences between Mars based and Earth based Capsule radio operation.

#### **5.3.4.5 ANTENNA**

The antenna pattern and gain characteristics are chosen to simulate the Capsule antenna characteristics.

### 5.3.4.6 PAPER TAPE DRIVE AND RECORDER UNITS

The paper tape drive unit controls power output and frequency of the transmitter and motion of the antenna according to pre-programmed schedules. The recorder makes a permanent record of power output frequency and antenna angles and station time signals.

### 5.3.5 CAPSULE RADIO SIMULATOR TEST AND CALIBRATION

The Capsule Radio Simulator is tested and calibrated with standard test equipment, or by use of the Relay Radio OSE self-test capability, or by use of the Capsule Radio OSE.

### 5.3.6 FLIGHT TESTS

All flight tests of the Relay Radio Subsystem utilize the Capsule Radio Simulator as a source of simulated and calibrated Capsule radio signals. Modulation is provided in fixed format by the code generator or in formats designed for specific tests through the tape reader.

### 5.4 INTERFACE DEFINITIONS

The Capsule Radio Simulator is a self-contained radio transmitter plus antenna. It is physically present at a convenient site (such as DSIF), but has no electrical interface with other equipment in the facility except for ac power input and time signal input.

### 5.5 PERFORMANCE CHARACTERISTICS

The Capsule Radio Simulator provides the following capability:

- a. Carrier strength calibrated to  $\pm$  0.1 db.
- b. Carrier frequency stability maintained to  $\pm 1$  part in  $10^6$ .
- c. Power level compatible with that specified for the Capsule.

### 5.6 PHYSICAL CHARACTERISTICS

The Capsule Radio Simulator is housed in two standard 75-inch high rack enclosures. Cooling is provided by a fan assembly mounted below the rear door of each rack. The simulator electronics are to operate in a controlled environment, while the antenna and drive are to operate in an exposed environment.

### **5.6.1 WEIGHT**

The approximate weight of the Capsule Radio Simulator is one thousand pounds.

#### 5.6.2 POWER

The power requirements are approximately 1000 watts. The primary supply is 105-125 volts, 46-65 cps, single phase. The equipment will be isolated from the primary source by quadruple shielded isolation transformers.

### 5.7 SAFETY CONSIDERATIONS

### 5.7.1 GENERAL

The Capsule Radio Simulator conforms to good engineering practice and provides circuit protection and safety devices such as current overload relays and voltage stabilized supplies.

Safety features such as cabinet interlocks, high voltage point insulation and warning notices are provided. Proper weight distribution minimizes the danger of tipping with consequent injury to equipment or personnel.

### 5.7.2 SPACECRAFT INTEGRITY

The nature of the Capsule Radio Simulator assures that its operation cannot affect space-craft safety.

### 5.7.3 FACILITIES

The nature of the interface at DSIF assures the safety of the facility.

# CII - VA270

# ASSEMBLY, HANDLING AND SHIPPING EQUIPMENT

# Index

1	Objectives and Design Criteria
2	Design Characteristics and Constraints
3	Assembly and Handling Fixtures
4	Interface Fixtures
5	Alignment Equipment
6	Handling Fixtures and Ground Transporter
7	Shipping Containers

# 1.0 OBJECTIVES AND DESIGN CRITERIA

### 1.1 SCOPE

This section delineates the functional objectives and design criteria for the 1969 Voyager Spacecraft Assembly, Handling and Shipping Equipment.

### 1.2 APPLICABLE DOCUMENTS

VA211SR101 - 1969 Voyager Spacecraft Mission Objectives and Design Criteria.

VB270SR101 - 1971 Voyager Spacecraft AHSE Objectives and Design Criteria

#### 1.3 OBJECTIVES

The objectives of the 1969 AHSE are the same as the objectives of the 1971 AHSE, except that they are addressed to the support of the 1969 Voyager spacecraft. These are defined in VB270SR101, Volume C.

#### 1.4 DESIGN CRITERIA

The design criteria which govern the 1969 AHSE design are the same as the criteria for the design of the 1971 AHSE, stated in VB270SR101, Volume C. The configuration of the 1969 Voyager Spacecraft will be the determining criteria of the AHSE design.

### 2.0 DESIGN CHARACTERISTICS AND RESTRAINTS

### 2.1 SCOPE

This section establishes the design characteristics and restraints applicable to AHSE for the 1969 Voyager Spacecraft test and launch operations.

### 2.2 APPLICABLE DOCUMENTS

### General Electric:

VB270SR102 - 1971 Voyager Spacecraft AHSE Design Characteristics & Restrints

VA270 - Section 1, 1969 Voyager Spacecraft AHSE Objectives and Design Criteria

### 2.3 DESIGN CHARACTERISTICS

The design characteristics for the AHSE for the 1969 Spacecraft are identical to the design characteristics of the 1971 AHSE, defined by document VB270SR102, Volume C.

### 2.4 DESIGN RESTRAINTS -

The design restraints for the AHSE for the 1969 Spacecraft are identical to the design restraints of the 1971 AHSE, defined by document VB270SR102, Volume C, with the following modifications:

- Wherever practicable, design peculiar to the 1969 Voyager spacecraft shall be accomplished so that the AHSE is also compatible with the 1971 spacecraft.
- The magnetic cleanliness restraint does not apply to articles which are b. neither to be ultimately used on the 1971 spacecraft nor interface physically with such articles.

### 3.0 ASSEMBLY AND HANDLING FIXTURES

### 3.1 SCOPE

This section is a functional description of the assembly and handling fixtures required to support the assembly of removable items of the 1969 Voyager Spacecraft.

### 3.2 APPLICABLE DOCUMENTS

GE

1969 Voyager Spacecraft Design Characteristics VA220SR101 -

VA220SR102 -1969 Voyager Spacecraft Design Restraints

Section 1, 1969 Voyager Spacecraft AHSE, Objectives and VA270

Design Criteria

VA270 Section 2, 1969 Voyager Spacecraft AHSE, Design Characteristics

and Constraints

VA270 Section 4, 1969 Voyager Spacecraft Interface Fixtures: Functional

Description

Section 5, 1969 Voyager Spacecraft Alignment Equipment VA270

Functional Description

VB270FD101 -Voyager Spacecraft Assembly and Handling Fixtures, Functional

Description.

### 3.3 FUNCTIONAL DESCRIPTION

The assembly and handling fixtures required for assembly of items to the spacecraft at the use site, are functionally identical to the fixtures described by document VB270FD101, applicable to the 1971 Spacecraft, except for the following:

- a. Power Subsystem The deployable solar arrays unique to the 1969 Space-craft will require entirely new assembly and handling fixtures.
- b. Communications Subsystem The 1969 Voyager spacecraft is equipped with a boom-mounted high-gain antenna as opposed to the 1971 antenna design. This design will require different assembly and handling equipment designs. The design philosphy for the equipment outlined in VB272FD101 will be observed for the 1969 spacecraft.

### 3.4 INTERFACE DEFINITION

### 3.4.1 SPACECRAFT ASSEMBLY FIXTURES - MECHANICAL

The differences in mechanical interfaces between the 1969 and 1971 vehicle assembly fixtures are functions of the differing configurations. The different solar array design for the 1969 vehicle requires a mechanical interface that allows for the deployment arrangment and for folding travel.

The boom-mounted high-gain antenna on the 1969 spacecraft requires modifications in the assembly equipment to allow for the different deployment action and deployed position.

#### 3.4.2 SPACECRAFT HANDLING FIXTURES - MECHANICAL

The change in high-gain antenna configuration requires a completely new antenna handling fixture design. The mechanical interfaces between fixtures and spacecraft will be of a design to support the installation, alignment and test of the boom-mounted design.

Provision for folding solar array panels on the 1969 Voyager spacecraft makes a new array handling fixture design necessary which gives different mchanical interfaces with the vehicle.

### 3.5 PERFORMANCE PARAMETERS, PHYSICAL CHARACTERISTICS AND CONSTRAINTS

All requirements listed in VB272FD101 for the assembly and handling equipment performance parameters, physical characteristics and constraints are directly applicable to the corresponding equipment supplied for the 1969 Voyager spacecraft.

### 3.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

The physical characteristics and contraints described in document VB270FD101, for the 1971 Spacecraft, are applicable, except that non-magnetic requirements do not apply, as long as contact with equipment intended for use in 1971 is not required.

#### 3.7 SAFETY PROVISIONS

The safety provisions described in VB270FD101 for the 1971 Spacecraft apply.

# 4.0 INTERFACE FIXTURES

### 4.1 SCOPE

This section is a description of the functions to be performed by the spacecraft interface fixtures where such functions or interfaces differ from those required for the 1971 spacecraft as noted in VB270FD102.

### 4.2 APPLICABLE DOCUMENTS

GE

VA220SR101	1969 Voyager Spacecraft Design Characteristics
VA220SR102	1969 Voyager Spacecraft Design Restraints
VA270	Section 1, 1969 Voyager Spacecraft AHSE, Functional Objectives and Design Criteria
VA270	Section 2, 1969 Voyager Spacecraft AHSE, Design Characteristics and Restraints
VA270	Section 3, 1969 Voyager Spacecraft AHSE, Assembly and Handling Fixtures Functional Description
VB270FD102	1971 Voyager Spacecraft Interface Fixtures, Capsule, Science and Booster Functional Description
VB270FD106	1971 Voyager Spacecraft Weight and CG Determining Equipment Functional Description

### 4.3 FUNCTIONAL DESCRIPTION

The functions of the interface fixtures required for the 1969 Voyager Spacecraft are the same as defined for the 1971 Voyager Spacecraft in document VB270FD102, with the following exceptions:

- a. Capsule Interface Fixture Since no lander capsule is provided for the 1969 Voyager spacecraft, a capsule interface simulation fixture will not be required.
- b. Science Interface Fixture All the functions required of the science interface fixture designed for use with the 1971 Voyager spacecraft will also be required

of the fixture provided for the 1969 spacecraft. The details of the design will be determined by the detail configuration of the Planet Scan Platform and spacecraft mounted experiments.

c. Booster Interface Fixture - The booster-spacecraft interface fixture designed for use with the 1971 spacecraft can be used for the 1969 configuration. A modification to the fixture will be required, however, to match the payload fairing to be used with the 1969 spacecraft.

#### 4.4 INTERFACE DEFINITION

#### 4.4.1 SCIENCE INTERFACE FIXTURE

The interfaces described in VB270FD102 for the 1971 Voyager spacecraft will also be typical for the 1969 spacecraft configuration.

#### 4.4.2 BOOSTER INTERFACE FIXTURE

The 1969 Voyager spacecraft design shows the payload fairing supported by the flange of the spacecraft support structure that mates with the Centaur forward bulkhead. There exists in this configuration no mechanical interface between the booster interface fixture and the fairing. This is a major difference in the booster interface fixture from the 1971 requirements where the fixture was required to provide a complete payload fairing mounting surface due to the great difference in the diameters of payload and payload fairing.

All other interfaces required of the booster interface fixture are the same as for the 1971 spacecraft. No new interfaces are involved in the 1969 design.

#### 4.5 PERFORMANCE PARAMETERS

All requirements on performance parameters for the 1971 Voyager spacecraft, stated in VB270FD102, Vol. C, interface fixtures are applicable to the 1969 configuration.

#### 4.6 PHYSICAL CHARACTERISTICS AND RESTRAINTS

The only modification foreseen at present in the Physical Characteristics and Restraints for the interface fixtures is in the relaxation of the magnetic cleanliness requirements. Since the 1969 spacecraft does not carry a magnetometer experiment, the stringent limitations on the 1971 vehicle support equipment can be relaxed for the 1969 design. Care must be exercised however to prevent contamination of that equipment usable for the 1971 spacecraft.

### 4.7 SAFETY PROVISIONS

The safety provisions applicable to the interface fixtures for the support of the 1971 Voyager Spacecraft, defined in VB270FD102, Vol. C, are applicable.

### 5.0 ALIGNMENT EQUIPMENT

### 5.1 SCOPE

This section is a functional description of the spacecraft mechanical alignment equipment, procedures and tolerances where they differ from those documented in VB291FD103 for the 1971 spacecraft.

### 5.2 APPLICABLE DOCUMENTS

 $\mathbf{G}\mathbf{E}$ 

VA220SR101	1969 Voyager Spacecraft Design Characteristics
VA220SR102	1969 Voyager Spacecraft Design Restraints
VA270	Section 1, Voyager Spacecraft AHSE Functional Objectives and Design Criteria
VA270	Section 2, Voyager Spacecraft AHSE Design Characteristics and Constraints
VB235FD105	1969 Voyager Spacecraft, Determination of Weight, Center of Gravity, Moments of Inertia and Products of Inertia Functional Description
VA220FD113	1969 Voyager Spacecraft Mechanical Alignment Tolerances
VB291FD103	1971 Voyager Spacecraft Mechanical Alignment Equipment Functional Description

### 5.3 FUNCTIONAL DESCRIPTION

The alignment requirements, techniques and procedures outlined for the 1971 Voyager spacecraft also apply to the 1969 vehicle except for the lander capsule, solar arrays and high gain antenna.

### 5.3.1 LANDER CAPSULE

Since the 1969 spacecraft does not carry a lander, no capsule to spacecraft alignment equipment is required.

### 5.3.2 SOLAR ARRAY

The change in Solar Array design from fixed to folding places a more severe burden on the array mechanism design, but the alignment check equipment will remain essentially of the same design and will check to the same tolerances as for the 1971 spacecraft.

### 5.3.3 HIGH GAIN ANTENNA

The boom mounted high-gain antenna design on the 1969 Voyager vehicle introduces serious alignment problems not present on the 1971 vehicle. These, however, are mechanical deployment problems. Maintenance of the antenna alignment tolerances will be much more difficult than on the 1971 vehicle. Checking of the alignments, however, while using equipment unique to the 1969 array configuration, will use the same techniques and check to the same required accuracies.

#### 5.4 INTERFACE DEFINITION

All interfaces between mechanical alignment equipment and spacecraft described in VB270FD103 exists for the 1969 spacecraft.

#### 5.5 PERFORMANCE PARAMETERS

All performance limits for the 1971 vehicle alignment equipment stated in VB270FD103 apply to the 1969 spacecraft with the exception of the capsule to spacecraft requirements. Again it is noted that though changes in configuration are made between the 1971 and 1969 spacecraft, the required alignment accuracies remain the same and the methods of achieving and maintaining those accuracies are not basically changed. The equipment needed to make the checks may differ to account for the different vehicle designs but the tasks to be accomplished remain the same. A detailed list of alignment tolerances is given in VA220FD113. The items covered herein represent gross tolerances of major subsystem alignment.

### 5.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

Of the general physical characteristics and constraints governing alignment equipment design for the 1971 spacecraft, only the magnetically permeable restriction can be relaxed. Since the 1969 spacecraft does not carry a magnetometer experiment, the tight control of spacecraft structural residual magnetism is not required. Those alignment fixtures which can also be used on the 1971 spacecraft, or are susceptable of modification to such use, will, however, have to be fabricated of non-magnetic and non-permeable material to the maximum practicable extend.

### 5.7 SAFETY PROVISIONS

The safety provisions stated in VB270FD103, for the 1971 spacecraft alignment equipment, are applicable.

# 6.0 SPACECRAFT HANDLING FIXTURES AND GROUND TRANSPORTER

#### 6.1 SCOPE

This section discusses the functions to be performed by the spacecraft handling fixtures and ground transporter required to support the 1969 Voyager test flight. The functions covered are either in addition to or different from those discussed in VB270FD104 for the 1971 flight.

## 6.2 APPLICABLE DOCUMENTS

GE

VA220SR101	-	1969 Voyager Spacecraft Design Characteristics
VA220SR102	-	1969 Voyager Spacecraft Design Restraints
VA270	-	Section 1, 1969 Voyager Spacecraft AHSE, Functional Objectives and Design Criteria
VA270		Section 2, 1969 Voyager Spacecraft AHSE, Design Characteristics and Constraints
VA270	-	Section 4, 1969 Voyager Spacecraft Interface Fixtures; Science and Booster, Functional Description
VA270	-	Section 5, 1969 Voyager Spacecraft Alignment Equipment Functional Description
VB270FD104	-	1971 Voyager Spacecraft Handling Fixtures, Ground Transporter and Dollies Functional Description

### 6.3 FUNCTIONAL DESCRIPTION

### 6.3.1 HANDLING FIXTURES

The handling procedures and fixtures required for the 1969 Voyager spacecraft will be basically the same as those shown for the 1971 vehicle in VB270FD104 with a modification to allow for the handling of the different payload fairing. A functional illustration of the 1969 vehicle fairing handling fixtures is shown in Figure 6-1.

### 6.3.2 GROUND TRANSPORTER

To provide ground mobility for the 1969 Voyager test vehicle, the same transporter configuration will be used as that proposed for the 1971 spacecraft. A different weather cover will be required due to the different spacecraft configuration, but this

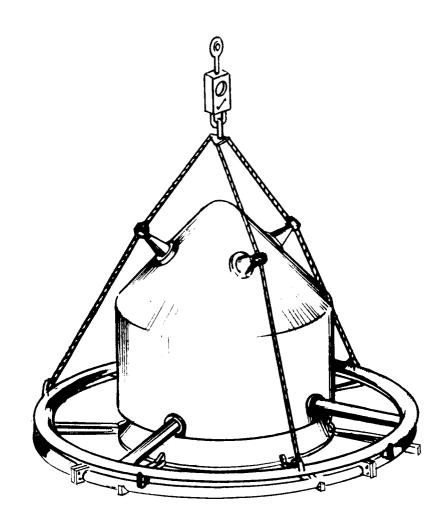


Figure 6-1. 1969 Voyager Spacecraft/Fairing Handling Fixture

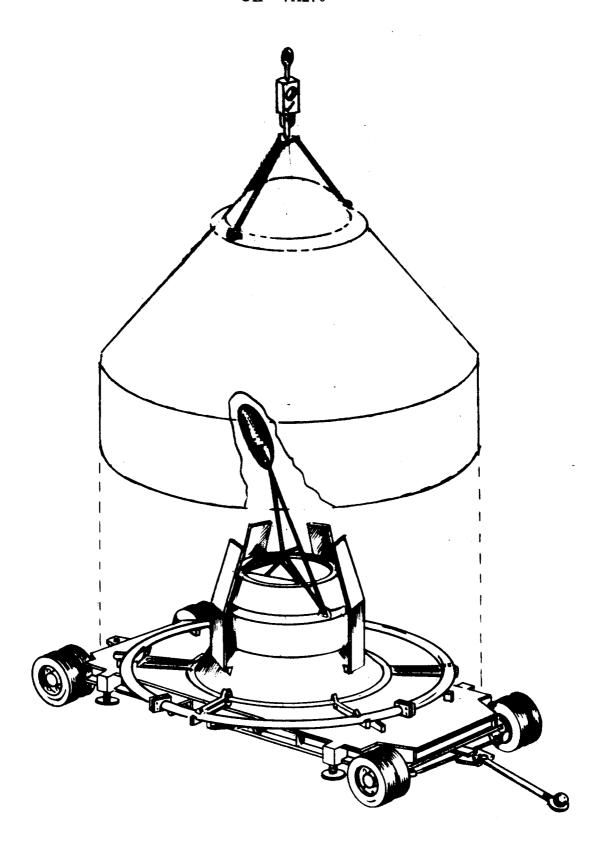


Figure 6-2. 1969 Voyager Spacecraft Ground Transporter
With Weatherproof Cover

will not affect the transporter configuration. A functional illustration of the ground transporter, spacecraft and weather cover is shown as Figure 6-2.

### 6.4 INTERFACE DEFINITION

## 6.4.1 SPACECRAFT HANDLING FIXTURES - MECHANICAL

Use of a different payload fairing for the 1969 launch requires a change in the mechanical interface design between the spacecraft handling fixture and the spacecraft fairing combination. This arrangement is shown in Figure 6-1.

### 6.4.2 GROUND TRANSPORTER

Since the spacecraft handling fixture actually mates with the ground transporter rather than the spacecraft itself, the 1971 ground transporter design can be used for the 1969 spacecraft.

### 6.5 PERFORMANCE PARAMETERS

All performance parameters identified with the handling fixtures and ground transporter for the 1971 spacecraft are applicable for use with the 1969 configuration-

### 6.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

The only change in the physical characteristics and design constraints for the equipment covered in this document is relaxation of the magnetic cleanliness and permeable materials restrictions since the 1969 vehicle carries no magnetometer experiment. This exception to the 1971 vehicle specifications shall not adversely affect the magnetic properties of the AHSE common to both vehicles.

### 7.0 SHIPPING CONTAINERS

### 7.1 SCOPE

This section is a functional description of the spacecraft shipping equipment required during transport of the 1969 Voyager Spacecraft. The shipping containers form part of the AHSE for the 1969 spacecraft.

#### 7.2 APPLICABLE DOCUMENTS

GE

VA270 Section 1, 1969 Voyager Spacecraft AHSE Functional Objectives

and Design Criteria

VA270 Section 2, 1969 Voyager Spacecraft AHSE Design Charac-

teristics and Constraints

VA270 - Section 3, 1969 Voyager Spacecraft Assembly and Handling Fixtures Functional Description

VB270FD107 - 1971 Voyager Spacecraft Shipping Equipment Functional Description

### 7.3 FUNCTIONAL DESCRIPTION

All basic functions required of the 1971 Voyager spacecraft shipping equipment described in VB270FD107, Volume C, are also pertinent to the 1969 spacecraft. An additional function required of the 1969 Voyager shipping equipment is that of providing structural support for the antenna boom and solar array panels during shipment. Because of the relative flexibility of these components compared with those on the 1971 vehicle design, these auxiliary support members will be used to provide protective restraint during movements. These support members will be removed before systems tests and before flight.

### 7.4 INTERFACE DEFINITION

All interfaces described in VB270FD107 as existing between the 1971 Voyager and its shipping equipment also exists for the 1969 Voyager. The mechanical tie-down points for the spacecraft within its shipping container are supplemented for the 1969 Voyager by the auxiliary member added to support and/or restrain the deployable solar arrays and high-gain antenna.

### 7.5 PERFORMANCE PARAMETERS

All performance parameters listed for the 1971 Voyager in VB270FD107 are pertinent to the 1969 Voyager. The attenuation of load inputs by shock mounts applies critically to the auxiliary supports added to the spacecraft shipping container to support/restrain the deployable elements of the system.

### 7.6 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

The physical characteristics and constraints applicable to the 1971 spacecraft shipping containers, described in VB270FD107, are applicable. The non-magnetic materials of -construction requirement is not applicable to the 1969 vehicle since the spacecraft system will not carry a magnetometer experiment. The auxiliary supports for the spacecraft deployable elements need not necessarily be elements of the container, but may be attached wholly to the spacecraft for shipping and movement purposes. The only physical difference between the shipping equipment supplied for the 1969 Voyager spacecraft and that for the 1971 vehicle is in the size of the shipping containers. Those for the 1969 configuration can be approximately one-half the size of those required for the 1971 design.

# 7.7 SAFETY PROVISIONS

The safety provisions for the 1971 spacecraft's shipping containers, described in VB270FD107, are applicable.